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FRUITS IN ICE CREAM AND ICES¹

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Commercial methods of preparing fruit ice creams and fruit ices vary greatly in different factories. Often so little fruit is used that excessive amounts of artificial color and flavor are added in order to give the product a fruit-like appearance and taste. The present trend apparently is toward the use of more fruit.

This circular is intended to supply the ice cream industry with tested methods of preparing frozen fruit desserts such as fruit ice creams, ices, and sherbets. It is based upon several years' experiments and many years' experience; but the formulas may be modified to meet local and seasonal conditions and the demands of the trade.

Most of the formulas are based on experiments conducted with the modern equipment of the Dairy Industry Division at Davis, illustrated in figure 1.

THE HEALTHFULNESS OF FRUIT ICE CREAMS AND ICES

Fruits in ice cream are an important supplement to the milk products, which usually contain a relatively small amount of vitamin C. This vitamin is abundant in many fruits, a fact which largely accounts for the wide-spread feeding of orange juice to infants and young children. Vitamin C is also of great importance to the health of adults.

Fruits contain mineral salts that during metabolism give basic residues, which tend to counteract the acid from bread and cereal diets.

¹ This circular replaces Bulletin 434, "Investigations on the Use of Fruits in Ice Cream and Ices," published in 1927 and now out of print.

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Some fruit ice creams and ices, especially those made with prunes, exert a mild but positive laxative effect. Not only are fruit ices lower in caloric (heat-producing) value than many foods, but their natural acidity is thirst-quenching and refreshing, and they are, therefore, valuable as desserts during the summer months. In short, the liberal use of fruit in ice cream seems desirable from the standpoint of health.

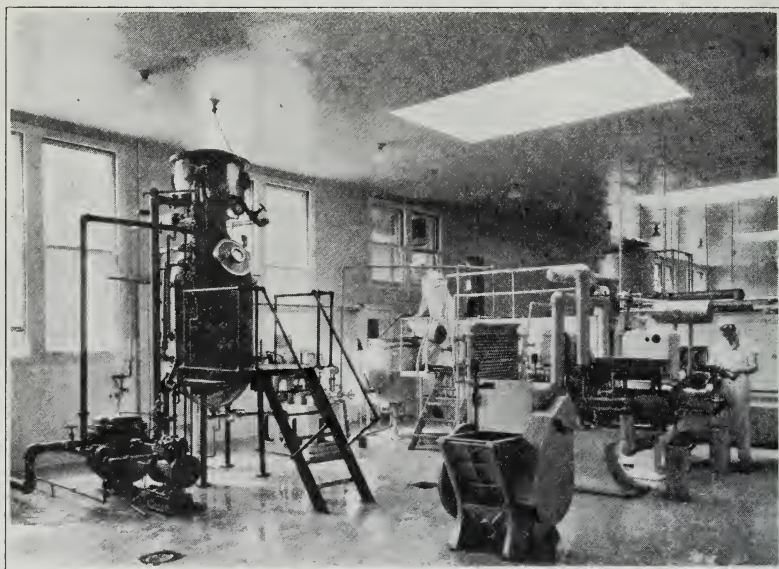


Fig. 1.—Two 40-quart freezers and other equipment used in experiments; Dairy Industry Division, University of California, Davis.

THE FORMS IN WHICH FRUITS ARE AVAILABLE

Fruits are available to the ice cream industry in fresh, cold-pack, canned, dried, and candied form; as fruit juices, fruit sirups, concentrates, jams, preserves, and—to a limited extent—fruit powders. There are also fruit products especially prepared for the trade.

Some of these products may be purchased advantageously in the open market; others may be prepared by the ice cream manufacturer and stored in the hardening room for subsequent use.

THE COST OF FRUITS IN ICE CREAM

On first thought, the fruit ice creams may appear more costly and less profitable than the plain ones. It must be remembered, however, that chocolate, strawberry, and other fruit ice creams usually bring several

cents a gallon more than the plain ice creams. Fruits added to the mix usually pay by increased volume for their own cost and for the slight additional expense of manufacture, so that ice creams made from them, as recommended in this publication, are in general no more expensive per gallon than plain vanilla ice cream.

BASIC ICE CREAM MIXES

In the commercial manufacture of ice cream, a basic mix containing milk fat, milk solids-not-fat, added cane sugar, and gelatin is prepared, pasteurized, and homogenized. To this are added fruits, vanilla, chocolate, or other flavoring as desired.

Composition.—Commercial ice cream mixes differ somewhat as to their composition, but a very satisfactory one for fruit ice creams contains 12 per cent fat, 10 per cent milk solids-not-fat, 15 per cent cane or beet sugar, and enough gelatin for proper stabilization.

Standardization.—There are several ways of standardizing ice cream mixes to give the desired ultimate composition. By the so-called “balance method,” one estimates the quantity of one or more of the milk products required, and then uses enough other ingredients to supply the required fat and milk solids-not-fat. Although common in the smaller ice cream plants, this is not the most satisfactory procedure. For more precise control of composition, the Pearson square or the formula method is preferred. There are, of course, several other satisfactory ways of standardization; the more popular are described elsewhere.⁵

OVERRUN

Overrun in ice cream is the ratio of the increase in volume to the volume of the original ingredients, or the ratio of the decrease in density to the final density. It is usually expressed in per cent and may be calculated in either of the following ways:

$$(a) \% \text{ overrun} = \frac{(\text{Vol. ice cream made}) - (\text{vol. of mix + flavoring material used})}{\text{Vol. of mix + flavoring material used}} \times 100$$

$$(b) \% \text{ overrun} = \frac{(\text{Wt. of 1 gal. mix and flavoring}) - (\text{wt. of 1 gal. ice cream})}{\text{Wt. of 1 gal. of ice cream}} \times 100$$

Some manufacturers calculate the overrun by considering only the volume of the mix, but obviously, as indicated in formulas *a* and *b* this is not a true representation of the changes taking place. Any recom-

⁵ Cole, W. C. Methods of standardizing ice cream mixes. California Agr. Exp. Sta. Cir. (In press.)

recommendations made in this circular are, accordingly, on the basis of per cent overrun obtained by one of the two methods given above.

An overrun of approximately 100 per cent is very generally obtained in commercial ice cream manufacture, although now, in many cases, the tendency is towards a lower overrun. With few exceptions, ice cream is more liable to be criticized for excessive than insufficient overrun, so that the trend toward a lower per cent overrun appears justified.

Because ice cream mixes vary considerably, and the optimum per cent of overrun increases with the total solids of the mix, no fixed and uniform overrun for all cases can be recommended. Usually, however, a very satisfactory product results from freezing the ice cream to contain 1.75 pounds of food solids per gallon. This amount would mean approximately 93 per cent overrun for an ice cream with 37.5 per cent total solids, or about 107 per cent for one of 40 per cent total solids. Obviously, a slight deviation from these values would not noticeably affect the quality of the ice cream.

THE MAXIMUM PERCENTAGE OF OVERRUN FOR ICE CREAM SOLD IN CALIFORNIA

The Agricultural Code specifying a minimum of 1.6 pounds of food solids per gallon for ice cream and 1.3 pounds of food solids per gallon for ice milk, guards against excessive overruns in these products. As already indicated, the best results are obtained when the standard is higher than that required by law. In case, however, one desires to calculate, for a given mix, the maximum per cent overrun legally possible, the procedure is easy.

Suppose for example, one wishes to know the maximum legal overrun for ice cream having 40 per cent total solids. One must first calculate the minimum legal weight per gallon of the ice cream :

$$\text{Min. legal wt. per gal.} = \frac{\text{Min. legal food solids per gal.}}{\text{Fraction total solids in ice cream}} = \frac{1.6}{0.40} = 4.0 \text{ lbs. per gal.}$$

Using the minimum weight calculated from this formula, and the weight of the mix,⁶ the maximum legal overrun is then calculated as follows :

$$\begin{aligned} \text{Max. legal \% overrun} &= \frac{(\text{Wt. 1 gal. ice cream mix}) - (\text{wt. 1 gal. ice cream})}{\text{Wt. of 1 gal. of ice cream}} \times 100 \\ &= \frac{9.0 - 4.0}{4.0} \times 100 = 125 \text{ per cent} \end{aligned}$$

In a similar way the maximum legal per cent overrun and minimum legal weight per gallon for ice milk may be calculated.

⁶ Ice cream mix is commonly assumed to weigh 9.0 pounds per gallon, although a mix of this composition would probably weigh slightly more.

WHEN TO ADD FRUIT IN MAKING ICE CREAM

In the manufacture of ice cream, fruit is added in one of the following ways: (1) to the freezer at the beginning of the freezing process; (2) to the freezer after the ice cream has been partially frozen; (3) to the ice cream by stirring or ladling after it has been drawn from the freezer.

Generally, the first method is to be favored since it results in a shorter freezing period and a more uniform distribution of fruit throughout the ice cream. The second and third methods attempt to incorporate the fruit without unduly breaking it into small particles. To a certain extent, this aim is accomplished in the second case; but the addition of fruit late in the freezing process warms the mass in the freezer and delays the freezing operation, thus offsetting the advantage of late addition. If the delay is too great, uniform distribution of the fruit may be difficult. Those who desire large particles of fruit in the ice cream may use the third method, although it may result not only in uneven distribution but in coarse-textured ice cream because partial melting occurs during the mixing process.

Since the present trend is toward a smooth ice cream and since the public is becoming more conscious of defects in texture, the fruit had best be added to the freezer early. Besides yielding a smoother texture, this method permits more rapid freezing and drawing of the ice cream from the freezer at the proper temperature and consistency.

THE RECOMMENDED FAT CONTENT OF FRUIT ICE CREAM

Ice cream mixes of about 12 per cent milk fat contain sufficient fat so that even after dilution with fruit the fat content of the resulting fruit ice cream is above the legal limit of 8 per cent. Mixes containing a considerably higher concentration of fat (up to 16 per cent) are increasingly used because improved flavor and texture result. In fruit ice creams, however, excessively high fat contents tend to mask the flavor, so that mixes of moderate fat content should be used in such products.

THE SWEETENING OF FRUITS FOR USE IN MIX

It is advisable that the freezing point should be about that of the mix; that is, the concentration of soluble solids in the fruit should be adjusted to that of the mix. One can best adjust the soluble solids content of the added fruit product by adding sugar or diluting with water as the case may require. If the fruit is uniformly incorporated, fruits and fruit

products that are too sweet will lower the freezing point of the mix, while those that are low in sugar will become "icy" in the frozen cream.

In general, the addition of about 20 to 25 per cent by weight of sugar will satisfactorily prevent the fruit from becoming icy. Most fruits readily absorb dry sugar if the mixture is allowed to stand overnight. Sometimes heating may be necessary to facilitate absorption of the sugar. The addition of more than $33\frac{1}{3}$ per cent sugar, especially to canned fruit, is not advisable.

THE HEATING OF SWEETENED FRUITS

Certain fruits are usually heated with sugar so that they will absorb it more uniformly and more rapidly; the practice also destroys certain enzymes that might impair the quality of the ice cream, and prevents icy particles of fruit from appearing in the frozen product. The heating should be as brief as possible; and the kettle should be of aluminum or stainless steel, copper being particularly objectionable because even very small amounts of this metal will seriously impair the quality of fruit ice cream. From 3 to 5 minutes of boiling is sufficient, and longer periods are not recommended because they usually decrease the fruit taste and sometimes produce off flavors. The fruit and sugar mixture should cool before being added to the ice cream mix. Subtropical fruits, particularly avocados and Japanese persimmons, should not be heated.

THE USE OF ARTIFICIAL COLORS AND FLAVORS

Artificial flavors in fruit ice cream are undesirable, being generally added to mask the lack of fruit. Under certain conditions, however, a small amount of suitable coloring, from certified dyes, may be justifiable. Directions for coloring appear in certain of the formulas. A slight amount of citric or tartaric acid improves the flavor of fruits lacking in tartness, but it should not exceed 0.5 per cent of the weight of the fruit. Vanilla, even in small amounts, masks the flavor of some fruits. Manufacturers should not add it indiscriminately to fruit mixes as is generally done. The addition of a spiced extract such as the following⁷ improves the flavor of pear and certain other mild-flavored fruit ice creams:

1 gallon water
1 pound cloves

8 ounces cinnamon sticks
1 dozen bay leaves

Mix these ingredients, heat to boiling, allow to cool, and strain. The extract is then ready for use.

⁷ The recipe for this spice extract was kindly furnished by William Dreyer of Oakland, California.

THE USE OF FRESH FRUITS IN ICE CREAM

Certain fresh fruits, when in season, are usually priced low enough for use in ice cream. Fresh peaches, apricots, raspberries, strawberries, figs, avocados, and persimmons are particularly suitable.

Measuring the Fruit and Mix.—Many ice cream makers measure out 5 gallons (45 pounds) of mix and add fruit or flavor to suit. They then freeze to the optimum overrun, usually securing about 10 gallons of ice cream. (See section on overrun.)

Others first weigh the fruit into a 5-gallon measure and then fill to the 5-gallon mark, or make the total weight to 45 pounds by adding basic mix. In most formulas, weights and measures are given for convenience in conformance with both procedures. The ice cream maker may take his choice of the two methods, although the second is preferable.

The following fresh fruit ice cream formulas are given in alphabetical order :

Fresh Apricot Ice Cream.—Soft, well-ripened fruit of the Blenheim or Royal varieties should be used. The Moorpark ripens too unevenly, while the Tilton lacks color and flavor.

Pit the fruit and grind it to medium fineness. Small hand-power food grinders are available, although in the ice cream plant either a small power-driven grinder (fig. 2), or a special "sieving" machine (fig. 3), is very useful. Place the pitted fruit in a kettle and to each 8 pounds add 2 pounds of sugar. Boil until cooked through—usually 3 to 5 minutes. Cooking is necessary, for without it the fruit turns brown and freezes hard in the cream.

To 45 pounds of unflavored basic mix add 8 to 10 pounds of the prepared cooled fruit (or add 7 pounds of fruit to 38 pounds of mix) ; freeze to optimum overrun.

Fresh Avocado Ice Cream.—In recent years, avocado production has greatly increased, and sound fruit unsuitable for fresh sale because of small size and blemishes is now sufficiently inexpensive to be profitably used. Avocado ice cream is a specialty in fair demand in high-class hotels, restaurants, and ice cream stands, generally bringing a higher price than vanilla and strawberry. Since the avocado has now become well known to most California housewives, this ice cream would probably meet with a favorable reception in the household.

The fruit should be soft, but not overripe. It must not be heated. Pit and peel thoroughly ripe avocados. Grind fine. Add 2 pounds of sugar to 8 of the pulp and stir till the sugar dissolves. Use at once; otherwise,

it will darken and acquire a disagreeable flavor. Add 20 per cent by weight to the mix; that is, add 9 pounds to 36 pounds of basic mix, and freeze to optimum overrun.

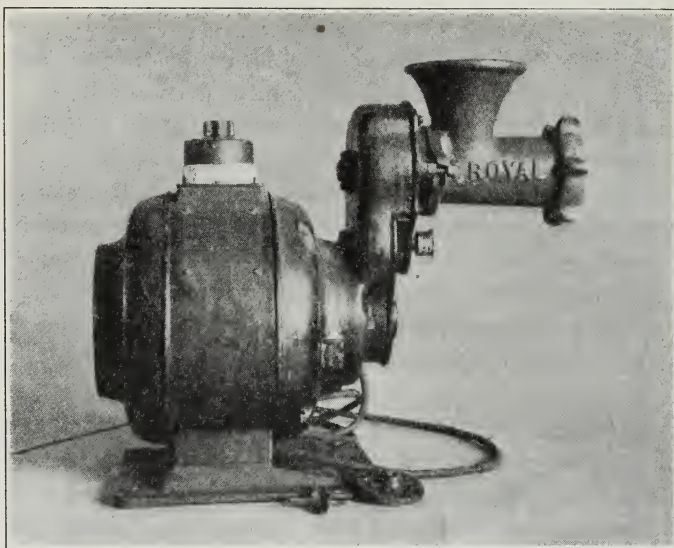


Fig. 2.—Small power-driven grinder suitable for grinding fruits.



Fig. 3.—Conical screw expeller press suitable for pulping whole fruits for use in ice cream. This machine grinds and sieves fruit in one operation.

Because avocado ice cream deteriorates in color and flavor on prolonged storage in the hardening room, it should be consumed promptly.

Fresh Banana Ice Cream.—Peel and grind sufficient well-ripened bananas to give 5 pounds of ground pulp. Add to 40 pounds of basic mix and freeze.

Fresh Cherry Ice Cream.—Because of the popular prejudice against combining fresh cherries and cream, the fruit had better be made into maraschino cherries before use. (See the later section on maraschino cherries.)

Fresh Fig Ice Cream.—Fig ice cream has proved popular in Texas; and in California, wherever advertised, it has been well received. The fig flavor carries well in the frozen cream, and the product is very attractive in color and general appearance.

Since figs with prominent seeds are preferable to those with very small seeds, the Calimyrna serves better than the Kadota, Mission, and White Adriatic varieties.

Use soft, ripe figs. Cut off the stem. Grind the fruit medium fine, and to 7½ pounds of the pulp add 1½ pounds of sugar. Boil 3 to 4 minutes. Cool. Add this quantity to 45 pounds of basic mix, and freeze.

Fresh Orange Ice Cream.—Although orange ice is much more popular, there is some demand for the ice cream. A generous amount of orange juice should be used, so that the ice cream will contain appreciable amounts of the vitamins and other desirable constituents. Orange ice cream may be prepared from juice extracted from the halved fruit by burring or from that secured by crushing and pressing the whole fruit in a continuous conical screw press (fig. 3). The latter method is finding greater favor, since the juice is easily prepared, is well fortified with oil from the peel, and yields a product with a pleasing taste and color. As the juice prepared by burring is rather mild in flavor, orange oil must be added to it. Both methods are described below.

Cut the oranges in half and extract the juice on a revolving-cone extractor (fig. 4). Strain through a screen or colander to remove seeds and coarse particles of pulp. To 3 quarts of the juice add 1 pint of fresh lemon juice, extracted by a revolving cone, and 3 pounds of sugar, dissolved by stirring. Add about 8 drops of cold-pressed orange oil. Pour the entire amount of juice into 45 pounds of mix, and freeze to optimum overrun.

In the alternative and preferred method for orange juice, quarter the washed fruit, and crush it in the conical screw expeller press (fig. 3). A fine screen should be used to yield a smooth product. To prepare larger amounts of this juice, pulp the whole oranges in a tomato "cyclone,"

made preferably of stainless steel, then pass the juice through a brush finisher having a fine, noncorroding metal screen. Each quart of juice (prepared by either method) is sweetened with about 1 pound of sugar. Small quantities of lemon juice may be added, as previously directed. The proportion of juice to be added to the mix will depend on the character of the fruit used, especially on the ease with which the oil cells in the peel are broken and on the consequent amount of oil in the mixture.

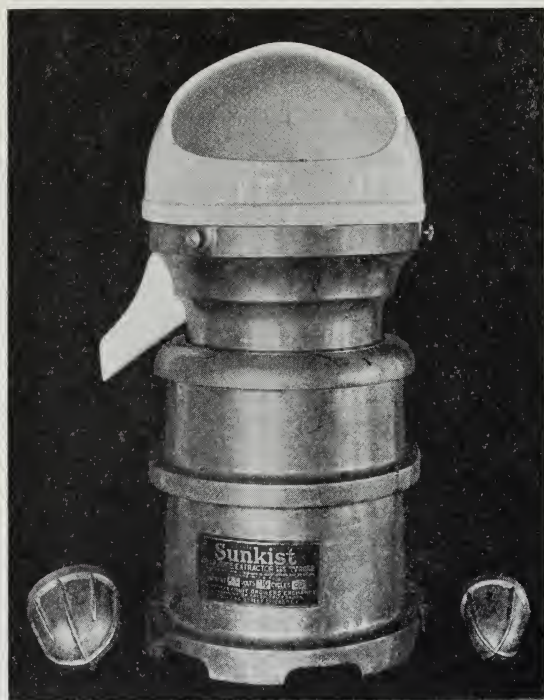


Fig. 4.—Revolving-cone citrus juice extractor.
(From Bul. 434.)

Generally the concentration used is approximately that given above for the burred juice—about 8 pounds to 37 pounds of mix.

Valencia oranges are preferable, as those of the Navel variety seldom give ice cream of satisfactory color and flavor.

Orange oil should be stored at 32° F to prevent development of a "rancid" or "turpentine" odor and taste.

Fresh Peach Ice Cream.—Only soft, highly flavored peaches are satisfactory for use in ice cream. The common California canning clingstone varieties are too tough and lack flavor. The common freestones grown

here for shipping and drying also lack flavor, though satisfactory in color and texture. About 20 per cent by weight of most varieties is required, since the peach flavor diminishes greatly in intensity on freezing.

Use soft, ripe, table or shipping varieties such as the "strawberry" types; lacking these, use Crawford, Elberta, or Lovell. Peel and pit. Often the peels can be loosened by parboiling in water or by a brief steaming, and can then be slipped easily from the flesh. Grind. To 10 pounds of pulp add 3 pounds of sugar. Boil 3 to 5 minutes. Cool. Add this at the rate of 9 pounds to 36 pounds of basic mix, and freeze.

Fresh Pear Ice Cream.—Pears have a mild flavor, which, however, does not appreciably diminish on freezing. The ice cream therefore possesses a characteristic and easily recognizable taste.

Bartlett pears, being finer-textured, are preferred to the fall varieties, though the latter may also be used.

Use thoroughly mature, but not overripe, pears; table ripeness is best. Peel. Cut in half and remove the cores. Grind. To 10 pounds of pulp add 2½ pounds of sugar. Boil about 5 minutes. Cool. Add at the rate of 9 pounds to 36 pounds of basic mix, and freeze. A trace of added yellow food color improves the appearance.

The spice extract described elsewhere is desirable and should be added to suit the taste.

Fresh Persimmon Ice Cream.—Persimmon ice cream is golden yellow and smooth, of good keeping quality and distinctive, pleasing flavor. It should prove a popular fall specialty when the fruit is in season.

Use soft, ripe persimmons free of astringency. Peel. Grind or crush coarse. Rub through a screen to remove seeds. Avoid unnecessary contact with iron, which will cause blackening. Add 3 pounds of sugar to 9 of pulp. Mix until completely dissolved. Do not heat, for heating greatly increases the astringency. Add at the rate of 9 pounds to 36 pounds of basic mix, and freeze.

Fresh Raspberry Ice Cream.—Wash and drain well-ripened berries of good color. Crush or grind. Add at least 6 pounds to 45 of basic mix. Add red color if required and freeze to optimum overrun.

Fresh Strawberry Ice Cream.—In order to deserve the name "strawberry ice cream," this product should contain not less than 6 per cent of fresh fruit by weight. Berries of deep color and solid flesh, such as the Marshall and Ettersburg, are far superior to the Banner, which is light colored and rather spongy. The city markets in California, however, contain few varieties except the Banner, or strawberries of similar character. A greater proportion of this variety than of the Marshall is required in order to give a satisfactory product.

Hull and wash well-ripened berries of good color. Grind. Add *at least* 4 pounds of crushed berries to 45 pounds of mix, and freeze.

No artificial flavor is necessary or desirable; it greatly cheapens the quality, imparting an unnatural odor and taste. With Banner strawberries a little artificial color may be required, but never a large amount.

A stale flavor develops in strawberry more readily than in vanilla ice cream for some unknown reason. Although various explanations have been suggested, the problem has not been solved. Interestingly enough, one factor tending to postpone the development of this objectionable flavor is the use of a large proportion of fruit—15 to 25 per cent, exclusive of the added sugar. This, of course, also improves the original flavor. There is, therefore, more than one reason for flavoring ice cream with relatively large amounts of strawberries.

THE USE OF FROZEN-PACK FRUITS IN ICE CREAM

Frozen-pack (also known as “cold-pack” and “frosted”) fruits are available for use in ice cream and generally prove as satisfactory as the fresh fruits. Where sufficient freezing storage (hardening-room space) is available in the ice cream factory, it will often prove less costly to prepare and store fruits fresh than to purchase them frozen.

Preparing and Storing Frozen-Pack Fruits.—Frozen-pack berries are often delivered in 50-gallon barrels to the ice cream manufacturer. Such large containers are objectionable unless the entire contents are used as soon as the barrel is opened, for the fruit deteriorates rapidly in color and taste, soon becoming unfit for use.

In purchasing frozen-pack fruits for use in ice cream, accordingly, one should specify 5-gallon cans, 30-pound egg tins, or 1-gallon tin cans. Similar containers (fig. 5) should also be used when the ice cream manufacturer prepares and packs fresh fruits for freezing storage. They can be used repeatedly and will last several seasons.

In packing for freezing storage, the fruit must be completely covered with added liquid, or crushed so that its own juice fills all the space between the pieces, in order to exclude air and thus preventing darkening of the color and oxidative destruction of flavor.

Stem, sort, and wash berries. Crush. Add 1 pound of sugar to 3 or 4 of berries. Dissolve by stirring. Pack in 5-gallon, enamel-lined, friction-top cans (fig. 5), in 30-pound egg tins, or in other suitable containers, leaving a head space about 10 per cent of the total depth unfilled to permit expansion during freezing. Store immediately at hardening-room temperature (15° F or lower).

Pit and peel peaches, apricots, and avocados. Grind. Add 1 part of sugar to 4 of ground fruit. Stir until dissolved. Pack and store in the hardening room as directed for berries. Work fast, for these fruits turn brown rapidly in contact with the air. Figs are prepared as directed for berries.



Fig. 5.—A 5-gallon can (right) and a 30-pound egg tin (left) for frozen-pack fruits. The cans must be enameled inside and out. (From Cir. 320.)

Persimmons should be used when soft-ripe. Peel. Rub through a screen to remove seeds, and then treat like berries.

Fresh fruit juices such as lemon, orange, and grape, are placed in the storage containers without added sugar. Store as directed for berries.

For further details, see Circular 320 of this Station.⁸

Using Frozen-Pack Fruits.—Crushed fruits stored frozen must be completely thawed before addition to the basic mix; otherwise, large ice

⁸ Joslyn, M. A. Freezing storage of fruits and vegetables. California Agr. Exp. Sta. Cir. 320:1-35. 1930.

crystals formed during storage will persist in the ice cream. The can of frozen fruit should be placed in running water, warm water if desired, until the contents are satisfactorily defrosted. Particular care should be used to avoid heating avocados and persimmons. Use as previously directed for fresh fruits, allowing for the dilution of fruit by the sugar present and omitting the addition of more sugar. Berries should be handled similarly.

Peaches and apricots should be melted quickly and heated to boiling for 3 or 4 minutes to destroy the enzyme that causes darkening. They should then be cooled and used according to the previous directions for fresh fruits.

THE USE OF CANNED FRUITS IN ICE CREAM

Several of the readily available commercially canned fruits have proved suitable for ice cream making. Among these are pineapple, apricots, figs, and pears. In addition, canned strawberries and cherries, artificially colored and flavored, are in general use.

So-called "solid-pack" pie-grade canned fruits in No. 10 cans are not only much lower-priced than the sirup-packed fancy, choice, and standard grades, but are usually riper and of richer color and flavor. They are, therefore, more satisfactory for use in ice cream. The water-pack pie-grade fruit, having been diluted, is, of course, less desirable.

Commercial canners will pack on order apricots, pears, peaches, or figs in a ground or sieved condition (purée). Fruits in this form are more conveniently used in ice cream and ices. Pie-grade canned fruits are obtainable in cases of six No. 10 cans each, direct from fruit canneries or wholesalers.

Apricots.—Rub the contents of one No. 10 can (about 6½ pounds) of apricots through a screen. (This step may be omitted if larger particles of fruit are desired in the ice cream). Add 1 pound of sugar and stir. Boil 2 to 3 minutes. Cool. Add to 38–39 pounds of basic mix and freeze.

Figs.—Grind the contents of one No. 10 can of solid-pack figs. Add to 39 pounds of basic mix, and freeze. For a "health ice cream" use 1½ cans of the ground fruit to 36 or 37 pounds of basic mix.

Peaches.—Grind the contents of two No. 10 cans of solid-pack peaches, preferably freestones. Add 4 pounds of sugar. Boil slowly for 5 minutes. Cool. Add 11 pounds of the prepared fruit to 45 pounds of basic mix, and freeze.

Pears.—Proceed as with peaches.

Crushed Pineapple.—To the contents of one case of No. 10 cans of crushed pineapple add 15 to 18 pounds of sugar. Mix well and allow to soak overnight, or boil for three minutes and cool. Add 10 pounds of this mixture to 35 pounds of ice cream mix, and freeze.

THE USE OF PRESERVES AND JAMS IN ICE CREAM

Although preserves and jams can be used in ice cream, they are generally less desirable than canned and frozen-pack fruits because of their high concentrations of sugar. If they are added in sufficient quantities to impart a distinct fruit flavor, the sugar unduly raises the solids content and depresses the freezing point, in addition to making the cream too sweet unless a special low sugar mix is used. If a small proportion of these products is used to avoid these difficulties, it will be insufficient in quantity to provide a fruit-like flavor and appearance. The relatively high cost of jams and preserves also militates against their use in ice cream. For these reasons their use in this product, or in water ices, is not recommended.

THE PREPARATION AND USE OF MARASCHINO CHERRIES IN ICE CREAM

Inquiries regarding the preparation of maraschino cherries for use in ice cream are frequently received. The following directions apply to ice cream manufacture rather than to the use of maraschino cherries in canned fruit salad or on the table.

“Brine” Storage.—Cherries for maraschino cherry manufacture must first be cured in a so-called “brine” consisting of a solution of sulfurous acid and lime. This hardens the tissues and bleaches the color so that the fruit will satisfactorily withstand subsequent cooking and dyeing.

Choose firm ripe (not soft ripe) Napoleon (Royal Ann) cherries with none to very little pink or red color. Place in paraffin-lined spruce kegs or barrels, fitted with 6 or 7-inch head bungs to facilitate filling. Do not stem or pit. Prepare a storage solution as follows:

Water	23 gallons
Six per cent sulfurous acid solution.....	2 gallons
Slaked lime	8 ounces

Add the sulfurous acid solution to the water. Then stir in the lime until it dissolves.

Fill the barrel of cherries with the solution and drive the head of the bung in place. Store indoors in a cool place for 6–8 weeks.

The sulfurous acid solution may be obtained from any chemical supply house.

Cooking and Dyeing.—The cherries are usually well cured by 6–8 weeks' storage in the brine. The flesh should become rather tough completely to the pit, which should become bleached in color.

Remove the cherries from the barrel and discard the storage brine. Remove the stems. Pit by means of a small hand pitter (fig. 6). The fact that this pitter lacerates the flesh of the cherries considerably, is not a serious objection, since the fruit used in ice cream is rather severely broken in freezing or is ground before use.

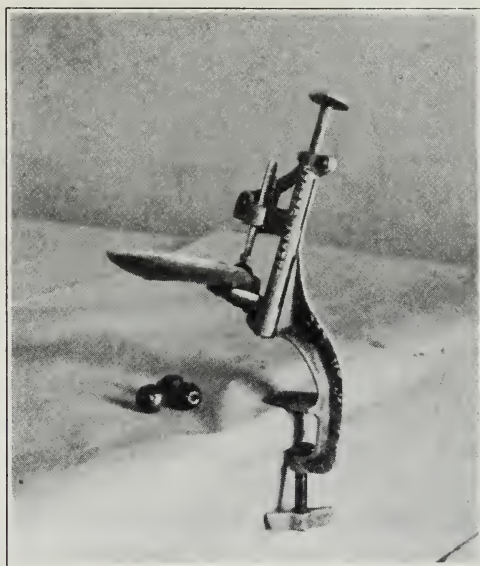


Fig. 6.—Hand pitter for cherries.

Place the pitted cherries in a kettle and boil in five or six changes of water, allowing about 5 minutes for each boiling, or a total of about 30 to 40 minutes. The cherries should now be free of any "sulfur taste," reasonably tender, but not soft.

Prepare a solution of $\frac{1}{2}$ ounce of ponceau-3-R and $\frac{1}{2}$ ounce of amaranth powders in a total of 5 gallons of water. Heat the cherries to boiling in this solution for 2 to 3 minutes. Set aside overnight and then break open several cherries to note depth of dye penetration and intensity of color. If the color is too weak, add more of the powdered dyes. If the solution has not penetrated the flesh completely, heat the cherries again to boiling and leave for 24 hours.

To this liquid then add 3 pounds of sugar and $\frac{1}{2}$ ounce of citric acid per gallon. Dissolve the sugar and heat the fruit to boiling in the sirup. Set aside for 24 hours. Next, add an additional pound of sugar per gallon of sirup. Again bring to boiling and set aside for 24 hours. Then add sufficient wild cherry flavor to the sirup, and allow the fruit to stand in the liquid for 24 hours.

Preservation.—Pack the cherries in their sirup in half-gallon fruit jars, leaving 2 to 2½ inches head space. Seal and store in the hardening room until needed.

Or pack in fruit jars, filling almost completely. Place rubbers and lids on loosely; do not seal. Then heat the jars in live steam in an enclosed steam box for 30 minutes. Remove and seal tightly. Store at room temperature or at 32° F.

Using Maraschino Cherries in Ice Cream.—Grind the cherries. Add 2¾ pounds to 45 of mix, color and flavor to suit, and freeze.

The coarse-ground cherries can also be used to advantage in coloring and flavoring various mixed fruit ice creams.

THE USE OF FRUIT JUICES, SIRUPS, AND CONCENTRATES IN ICE CREAM

Orange juice is better suited than most other juices for use in ice cream. Although grape, berry, apple, pineapple, and several other juices will serve, they are much more suitable for water ices, in connection with which their preparation and use will be described.

The making of fresh orange juice ice cream is described in the section on the use of fresh fruits.

Orange sirup, now obtainable on the market, may be substituted for the fresh juice by adding a volume equivalent to the amount recommended for fresh orange ice cream.

Orange concentrates of good quality, made by concentrating the juice *in vacuo*, are now obtainable and may be used in ice cream; but fresh orange juice should be added also to furnish the fresh fruit flavor lacking in the concentrate. The following formula is recommended:

Orange concentrate	1 pound
Fresh orange juice.....	1 pound (1 pint)

Mix and add to 45 pounds of basic mix, with a little orange oil and orange color to suit; freeze to optimum overrun.

Orange concentrate should be stored at 32° F, for it rapidly darkens in color and deteriorates in flavor at room temperature.

THE PREPARATION, PRESERVATION, AND USE OF FRUIT MIXTURES IN ICE CREAM

Tutti frutti, "fruit salad," and mixed fruit ice creams under various other names are in fair demand, and their use could probably be much extended if sufficient of the most suitable fruits were used. Too often such ice creams contain very little fruit and are artificially flavored and colored.

Most fruit mixtures on sale in this state for the ice cream trade have proved, upon examination, to be of a pasty or jam-like consistency; they were usually packed in No. 10 cans or in large fruit jars. Many consisted chiefly of shredded coconut, colored and flavored in imitation of fruit. All samples of fruit mixes, even those containing only fruit, were artificially colored and flavored. The sugar content was high, generally above 60 per cent, a fact that would preclude using an adequate proportion in ice cream were it not for the artificial flavor added.

Commercially Canned Fruits for Salad.—Fancy or choice mixed fruits in sirup of 20° to 24° Brix (20 to 24 per cent sugar) are obtainable from commercial canners at very moderate cost. They consist of about equal proportions of apricots, pears, peaches, and pineapple, plus a few maraschino cherries. The flavor is very pronounced—a blend of pineapple, cherry, and apricot.

In using the canned "fruits-for-salad," grind the fruit coarse, mixing the juice from the cans with the ground fruit. Add 0.5 per cent of citric acid—that is, $\frac{2}{3}$ of an ounce to 8 pounds of fruit. Use the contents of 1½ No. 10 cans to 45 pounds of mix and freeze; or use 1 No. 10 can of fruit to 38–39 pounds of mix, and freeze.

Fruit Mixtures Preserved by Freezing.—During the fresh fruit season various fruits can be prepared, ground, mixed, sweetened, packed in suitable containers, and placed in freezing storage in the hardening room. Of the many possible mixtures, two examples will be given.

A satisfactory mixture containing berries is prepared as follows:

- 6 pounds hulled, washed strawberries, loganberries, raspberries, or young-berries
- 6 pounds apricots
- 6 pounds early peaches

Crush. Mix. Add 4½ pounds of sugar and 1½ ounces of powdered citric acid or 3 ounces of a 50 per cent solution of citric acid. Pack in suitable cans such as 30-pound egg tins, and store in the hardening room.

In the following mixture, canned pineapple and maraschino cherries are added for flavoring :

- 6½ pounds fresh apricots (pitted)
- 6½ pounds early fresh peaches (pitted and peeled)
- ½ pound maraschino cherries
- 1 No. 10 can (6½ pounds) crushed pineapple

Grind. Mix. Add 5 pounds of sugar and 1½ ounces of powdered citric acid or 3 ounces of 50 per cent citric acid solution. Store in suitable containers in the hardening room. Add these mixtures at the rate of 15–20 per cent by weight to the mix; that is, 8–11 pounds to 45 of mix, or 7–10 pounds to 38, and freeze to optimum overrun.

Mixtures of Canned Fruits.—Commercially canned fruits suitable for preparing mixtures may be had at moderate cost; pineapple, peaches, pears, and apricots are useful. Here is a typical mixture :

- | | |
|--------------------------------|---------------------------------|
| 1 No. 10 can crushed pineapple | 1 No. 10 can pie-grade pears |
| 1 No. 10 can pie-grade peaches | 1 No. 10 can pie-grade apricots |

Grind. Mix. Add 6 pounds of sugar and 1½ ounces of powdered citric acid, or 3 ounces of 50 per cent citric acid solution. Dissolve by stirring. Use in ice cream as directed for the cold-pack fruit mixture. A portion not used at once can be preserved by freezing storage.

If desired, about 3 pounds of ground or chopped maraschino cherries may be added to the mixture.

An excellent pineapple-apricot blend can be prepared by mixing two parts of canned apricots to one part of crushed pineapple and adding 20–25 per cent of sugar and 0.5 per cent of citric acid.

The addition of 1 pound of maraschino cherries to 9 pounds of this mix gives a desirable variation.

An excellent fruit salad mixture can be prepared by mixing equal parts of canned apricots, pears, and pineapple with 5 to 10 per cent of ground maraschino cherries and adding 20 per cent of sugar and 0.5 per cent of citric acid.

Dried-Fruit Mixtures.—Although these will be found less desirable than the fresh, canned, or frozen-pack fruit mixtures, several satisfactory combinations can be prepared. The following is typical.

Place 3 pounds each of dried apricots, seeded Muscat raisins, and dried white figs in separate vessels, allowing 2 gallons of water to each 3 pounds of dried cut fruits and 1¼ gallons to the raisins. Soak overnight. Heat the apricots and figs and boil gently until soft. Heat the raisins barely to boiling, and remove from the kettle to cool. Grind or

crush the apricots and figs. Add the whole raisins and the juice from the boiled fruit, with about 6 pounds of sugar. Mix. Use at the rate of 8 pounds to 45 of mix, and freeze to optimum overrun.

THE USE OF CANDIED OR GLACÉ FRUITS IN ICE CREAM

In the manufacture of candied and glacé fruits, considerable quantities of broken pieces unsuitable for packaging are sold relatively cheap. As the average ice cream factory uses only small amounts of such fruits, it will usually be inadvisable to conduct candying and glacéing operations in the ice cream plant.⁹

Large pieces of candied fruits such as apricots, pears, pitted plums, and pineapple may be cut into smaller pieces (quarters or eighths) and used in "au fait" ice creams—that is, placed between layers of different kinds of ice cream and cut into bricks.

Broken pieces may be chopped or coarsely ground and used in frozen fruit puddings, tutti frutti ice creams, and the like. They should be mixed before being added to the cream or basic mix. To prevent the particles sticking together, one may add to them a portion of the ice cream mix before placing them with the remaining mix in the freezer.

One advantage of using candied fruit is that the particles are conspicuous and add to the appearance of the ice cream. Having a high sugar content, they do not become icy. Often, they may well be used in addition to other forms of fruit incorporated with the mix. Candied fruit suitable for this purpose should be rather soft, of full flavor, and so prepared that the color is little leached by the mix. Such products are now available commercially and when used primarily for appearance rather than flavor generally prove popular.

THE USE OF DRIED FRUITS IN ICE CREAM

Among dried fruits, prunes and raisins appear to have the greatest commercial possibilities. Although dried apricots, peaches, and figs can be used in ice cream the canned and cold-pack fruits of these varieties serve much better and are far more convenient. For these reasons, most of the following discussion will be devoted to prunes and raisins.

Prunes.—Prunes are used in the diet largely because of their well-known laxative effect.

⁹ Directions for making fruit candy may be found in: Cruess, W. V., and Agnes O'Neill. The home preparation of fruit candy. California Agr. Ext. Ser. Cir. 10: 1-32. 1932.

Prune ice cream has a very attractive appearance and a pleasing flavor. Prunes in this form will probably appeal to anyone who likes ice cream and will be especially desirable for children and for convalescents in hospitals, sanitariums, or the home.

Ice cream has been made with prunes prepared in the following ways:

(a) With canned prune pulp:¹⁰ The most satisfactory of the tested methods of preparing prunes for the ice cream trade is as follows. Boil dried prunes in water until soft and then pass them through a medium-coarse screen in a tomato pulper that separates the pulp from the pits. Heat the resulting pulp almost to boiling, place in No. 10 cans, seal hot, and sterilize in boiling water. The resultant product containing about 60 per cent of water, can be made at small cost by any fruit cannery, and is now available to the ice cream trade. It is sold in No. 10 cans, six to the case.

In making an ice cream for the fountain and home trade, use 11 pounds of the pulp to 45 of mix; or add 9 pounds to 36 of mix, and freeze to optimum overrun.

A health ice cream is made by adding about 30 per cent of the pulp to the mix; this would be about $12\frac{1}{2}$ pounds to every $32\frac{1}{2}$ pounds of basic mix. Freeze to optimum overrun. Because of the extraordinarily large proportion of pulp in this case, legal standards will require a basic mix containing approximately 12 per cent fat.

(b) With dried prunes: The ice cream maker can prepare prune pulp readily in the plant without special equipment as follows: To 7 pounds of washed prunes add 4 quarts of water. Bring to boiling and allow to stand overnight. Then boil gently until soft, rub through a coarse screen or colander to remove seeds, and use as directed for canned pulp.

Raisins.—Considerable quantities of raisin ice cream have been manufactured in the eastern United States. Usually, however, the mistake has been made of using Thompson Seedless raisins, which are almost wholly lacking in flavor. Muscat raisins, on the other hand, possess a very marked and pleasing flavor, readily recognized in the ice cream. A mixture of Muscat and Thompson Seedless is, however, also satisfactory. Two formulas are given—one (a) with Muscat only, and another (b) with Muscat and Thompson Seedless.

(a) To 5 pounds of Muscat raisins add 3 pints (3 pounds) of water. Mix well. Warm gently, almost to the simmering point (about 165° F), but do not allow to boil. Set aside for about two hours, stirring occasionally to facilitate absorption of the water. Grind one-half of the

¹⁰ Mrak, E., and W. V. Cruess. Utilization of surplus prunes. California Agr. Exp. Sta. Bul. 483:1-34. 1930.

raisins. Mix with the unground fruit and the sirup. Add to the 45 pounds of unflavored ice cream mix, and freeze to optimum overrun.

(b) To 2½ pounds of Muscat raisins, add 1½ pounds of water; heat, soak, and grind all the raisins as directed above. Prepare 2½ pounds of Thompson Seedless in similar manner, but do not grind. Mix the ground Muscats, the whole Thompson Seedless, and the sirup. Add to 45 pounds of mix, and freeze to optimum overrun.

Figs.—Dried figs, being much less satisfactory than fresh or canned, are not recommended unless other forms cannot be obtained. The Calimyrna is best; the Mission second. The addition of sugar in cooking is desirable in order to prevent freezing of the fig meat to an icy texture.

To 2 pounds of dried figs, add 3 quarts of water. Soak overnight. Add 1½ pounds of sugar. Cook slowly until tender—about 1 to 1½ hours. Weigh; and if the weight is less than 6 pounds, add water to make up the difference. If it is more than 6 pounds, boil off excess water until a weight of about 6 pounds is attained. Cool and then grind. Add to 45 pounds of ice cream mix, and freeze. The addition of a little vanilla flavor is desirable.

The cooked whole figs and those cut in half, particularly Missions, are suitable for use in au fait.

Apricots.—Dried apricots are less satisfactory than fresh or canned. They may, however, be treated like dried figs, except that 1½ pounds of fruit, 1 pound of sugar, and 3 quarts of water are used. Bring the final cooked weight to 6 pounds. Add to 39 pounds of mix, and freeze.

Other Dried Fruits.—Dried pears, peaches, and apples are not recommended for use in ice cream.

THE USE OF FRESH FRUITS IN ICES AND SHERBETS

The distinction generally made between ices and sherbets is that sherbets contain milk solids, while ices do not. The methods of making the two, however, are essentially the same, since a sherbet is usually prepared by adding the desired amount of milk solids to a basic ice mix.

Although sherbets can sometimes not replace ices, they are in general preferred. The milk solids improve the texture, and many consumers consider a sherbet more palatable than an ice, and equally refreshing. In either case, a liberal amount of fruits or fruit juices will improve the finished product.

Fruit ices and sherbets are ideal frozen desserts for summer months, being acid in flavor and thus thirst-quenching and refreshing. They deserve greater popularity than they have at present.

Stabilizers.—Unless proper stabilizers are used in ices and sherbets, serious defects in texture may develop during storage. During a series of comparisons in which agar, gum tragacanth, India gum, pectin, sodium alginate, and gelatin were used singly and in combinations of two or more, the use of 0.2 per cent agar and 0.2 per cent gelatin, or 0.2 per cent agar and 0.2 per cent pectin, proved most satisfactory. "Bleeding" was seldom a serious defect in either case, nor were flavor and palatability injured by the stabilizers. Where pectin alone was used to the extent of 0.5 per cent, the products, though smooth, were inclined to be sticky; they did not readily melt down to a punch-like consistency in the mouth and were, therefore, less refreshing than ices and sherbets made with the other stabilizers.

Pectin is preferred, however, for juices whose coloring matter and tannins react with gelatin to form an objectionable grayish-white precipitate. Gelatin is satisfactory with juices such as orange and lemon.

Standardization of Acidity in Ices.—The acidity of water ice is known to have an effect upon texture as well as flavor. The proper standardization of acidity in ices and sherbets is therefore a factor of importance in their manufacture. Though the optimum acidity will vary somewhat, a very satisfactory product can be made by standardizing the acidity to between 0.50 and 0.55 per cent acid calculated as citric, or 0.70 to 0.75 per cent acid, calculated as lactic. Since citric or tartaric acids are most commonly used in standardizing the acidity of ices and sherbets, and since their equivalent weights are essentially the same, the standardization may best be made on the basis of citric rather than lactic acid content. This can be done by the use of volumetric titrations, as indicated below.

$$\text{Per cent citric acid} = \frac{\text{cc N/10 NaOH} \times 0.0064}{\text{Grams of sample}} \times 100$$

By using a pipette that will deliver 6.4 grams of the sample, one can take the per cent acid directly from the burette reading. The only difference between the determination of citric acid and that of lactic acid, as ordinarily carried out in the plant, will be in the use of pipettes of different size. If a 9 or 18 cc pipette is more convenient, calculate the per cent acid as lactic and then convert it to per cent citric acid by multiplying the value by 0.71.

The following example illustrates the method of standardization. If 2.0 cc of N/10 NaOH are required to neutralize the acidity in a 6.4 gram sample (approximately 6.4 cc), the percentage of citric acid can be calculated as follows:

$$\frac{2.0 \times 0.0064}{6.4} \times 100 = 0.2 \text{ per cent citric acid}$$

This is equivalent to multiplying by 0.1 the cubic centimeters of N/10 NaOH used. The amount of acid to add can then be calculated as follows:

$$\text{Weight of ice mix} \times \frac{(0.50 - 0.2)}{100} = \text{weight of acid required}$$

If the weight of the mix were 100 pounds, this would be 0.3 pound; or $0.3 \times 454 \text{ grams} = 136.2 \text{ grams}$.

A convenient way to add the acid is in the form of a 50 per cent solution. Once the correct weight of acid has been calculated, the correct volume of the 50 per cent solution can be added more easily than the crystals, since the latter must be weighed and then dissolved.

Basic Water Ice Mix.—In accordance with the foregoing conclusions regarding acidity and stabilizers, the following basic mix is suggested for red juices:

Cane sugar	21	pounds
Pure corn sugar crystals.....	7	pounds ¹¹
Agar agar, highest grade, powdered.....	0.15	pound (2½ ounces)
Powdered pectin, or gum tragacanth, powdered.....	0.35	pound (5½ ounces)

For other juices the gum tragacanth or pectin can be replaced by the same amount of powdered gelatin. Make to 80 pounds with water and add sufficient citric acid to give, when mixed with fruit or fruit juice, a final acidity of 0.5 per cent as citric. Ordinarily, this may be taken as about 6 to 7 ounces of citric acid to 100 pounds of mix after addition of fruit.

Proportion of Fruit.—In most cases 20 per cent by weight of fruit or fruit juices is recommended. Sometimes a greater proportion than this may be needed, if the flavor of the fruit is not very pronounced.

Fresh Apricot Ice.—As in ice cream, the cooked, fresh apricots surpass the raw fruit for use in water ice.

To 10 pounds of pitted, ground, thoroughly ripe apricots, add 2½ pounds of sugar. Boil 3 to 5 minutes and cool. Add 9 pounds to sufficient basic water-ice mix to give 5 gallons. Freeze to not more than 35 per cent overrun.

The basic mix in this case should be made with about 6 ounces of citric acid to each 100 pounds of mix, or with lemon juice to give the desired acidity.

Fresh Berry Ices.—Fresh berries are very satisfactory for use in water ices, strawberry being the most popular and loganberries and raspberries probably next best. Cranberry water ice is in demand at Thanksgiving and Christmas.

¹¹ Pure commercial corn sugar (such as Cerelese or Clintose) may be used.

Uncooked berries are generally best for use in water ice. Cranberries, of course, are an exception and must be cooked before freezing.

Although various proportions of the prepared berries may be used, 20 per cent or more, added to the basic mix, usually gives the best results. Much less than this amount makes the flavor and color too dilute. An ice consisting almost entirely of crushed berries, sugar, and stabilizer with very little added water has appeared in certain of the better ice cream stands and restaurants. It is known as "frozen berries" and is a very satisfactory product if properly made.

(a) Blackberry, loganberry, raspberry, and strawberry ices: To 10 pounds of hulled, washed, crushed berries, add 3 pounds of cane or beet sugar. Stir until dissolved. To 9 pounds add enough basic water ice mix to give 5 gallons, and add citric acid to increase total acidity to 0.5 per cent; or use a basic mix containing, in each 100 pounds, about 6 ounces of citric acid. Freeze to about 35 per cent overrun. If more than this proportion of berries is used, increase the stabilizer and sugar in the basic mix correspondingly.

(b) Cranberry ice: Cranberries give a rather bitter ice unless first blanched in boiling water.

To 9 pounds of cranberries, add $1\frac{1}{4}$ gallons of boiling water; let stand for 2 minutes, and then discard the water. Again add 1 gallon of water and $2\frac{1}{2}$ pounds of sugar. Boil until the berries are soft. Rub through a colander or screen, and add 9 pounds to enough basic water ice mix to give 5 gallons. Freeze to about 35 per cent overrun.

Fresh Grape Ice.—Fresh grapes, in season, can be used to good advantage in water ice. Juice from thoroughly ripe Muscats or even a mixture of Muscat with any red grape juice is satisfactory. The eastern varieties such as Pierce Isabella, and Concord surpass most California (Vinifera) varieties for water ices.

To extract the juice from Muscats, crush thoroughly in a fruit juice press or by squeezing the crushed grapes in a cloth sack. The juice should be strained through cheesecloth or a sugar bag to remove coarse particles, but need not be perfectly clear.

To extract red juice, such as Pierce Isabella, Alicante Bouschet, and Zinfandel, crush the grapes thoroughly; heat to about 160° F; and press or squeeze through a bag.

Add no sugar. To 6 or 8 quarts of the juice, add enough basic water-ice mix to give 5 gallons. Each 100 pounds of the basic mix should contain about 6 ounces of citric acid. Freeze to not more than 35 per cent overrun.

Fresh Lemon Ice.—For use in water ice, the juice expressed on a revolving cone proved to be better flavored than that obtained by pressing the whole fruit. The following formula is satisfactory:

Cut the lemons in half and express the juice. Strain out the seeds and coarse pieces of "rag." To 3 pints of the juice, add 3 pounds of sugar and 3 pints of water, with basic mix to give 5 gallons. If the flavor is faint, add a few drops of best quality lemon oil or extract. A small amount of lemon-yellow color improves the appearance. Every 100 pounds of basic mix in this case should be made with about 4 ounces of citric acid. (Lemon juice usually contains about 6 per cent citric acid.) Freeze to not more than 35 per cent overrun.

Lemon juice for use in ice can also be prepared by crushing the whole fruit as previously described.

Fresh Orange Ice.—Orange ice made with the fresh juice is much superior in flavor to that made with sirups or concentrates. Most factories now use too little juice and altogether too much artificial color and flavor. There should be at least $4\frac{1}{2}$ quarts of fresh juice with basic mix to give 5 gallons. Where obtainable, cull or "juice grade" oranges serve the purpose as well as the higher-priced fruit. The Valencia gives ices of slightly better flavor than the Navel, but the difference is slight. The basic mix should contain about 0.4 per cent acid before addition of the orange—that is, about 6 ounces of citric acid in 100 pounds of mix. Unless oranges are thoroughly ripe, the juice will taste bitter.

To prepare the ice: Extract the juice from the halved fruit on a revolving cone. Strain through a sieve or colander to eliminate seeds and very coarse pulp. To $4\frac{1}{2}$ quarts of juice, add basic mix to give 5 gallons. Add a little, not too much, coloring if needed, and a very small amount of orange oil. Freeze to about 35 per cent overrun.

Orange juice for ice can also be prepared by pressing the whole fruit as described in the section on orange ice cream. Sometimes peels are grated with the juice to intensify the flavor.

Fresh Peach Ice.—The common canning and drying varieties of peaches are not satisfactory in ice. If highly flavored, juicy, table peaches are obtainable, peel and proceed as with apricot ice.

Fresh Plum Ice.—In experiments made in 1922,¹² highly colored varieties of plums such as the Damson, Blue Diamond, Satsuma, and Grand Duke proved to be satisfactory for water ices. The following procedure is recommended:

¹² Cruess, W. V. Utilization of surplus plums. California Agr. Exp. Sta. Bul. 400:1-21. 1926. (Out of print.)

Use thoroughly ripe plums. Crush. To 10 pounds, add 1 gallon of water. Boil 4 to 5 minutes. Strain through a sugar bag. To each gallon of juice, add 3 pounds of sugar. To 6 to 8 quarts of the sweetened juice add basic water-ice mix to give 5 gallons. Freeze to approximately 35 per cent overrun. The basic mix used should contain about 5 ounces of citric acid in 100 pounds.

Fresh Pomegranate Ice.—Because, in the average ice cream plant, the juice is very difficult to express, bottled juice should be used. Pomegranate ice is fairly satisfactory, having good color but mild flavor.

THE USE OF BOTTLED FRUIT JUICES IN WATER ICE

Juices from fresh fruit are, naturally, better than those preserved by heat or other means, but unfortunately the season for many fruits is short and does not correspond with the period of greatest demand for ices. Consequently, the preserved juices must be used to some extent.

Bottled grape, loganberry, apple, citrus, and pomegranate juices preserved by pasteurization are obtainable. They may be most economically purchased by the case in gallon bottles. Pineapple juice is available in canned form.

The bottled citrus juices are very unsatisfactory because of their pronounced cooked flavor; and in some cases, especially in samples more than six months old, a very disagreeable “stale” or “turpentiney” taste develops. Investigators have found no practicable method of preserving fresh citrus juices except by freezing storage or by conversion into sirups and concentrates.

Among satisfactory juices may be mentioned pomegranate, loganberry, and blackberry, which are slightly sweetened with sugar before bottling; and grape, which is not sweetened. These juices give good results when used in the same manner as the fresh—that is, 4½ quarts are added to sufficient basic water-ice mix to give 5 gallons. Pomegranate, because of its rather mild flavor, is the least desirable.

Strawberry juice a few weeks after bottling becomes very poor in color and much inferior to the fresh berries in flavor. All things considered, the cold-pack strawberries are the only satisfactory substitute for the fresh.

Although a satisfactory ice can be made with apple juice, it is rather insipid, when compared with fresh strawberry, grape, and orange ices. It seems, therefore, to have no very great commercial possibilities in this state; consumers prefer to use unfermented cider as a beverage.

The formulas for the various fresh juices can be used with the bottled ones.

THE USE OF FRUIT CONCENTRATES IN WATER ICES

Fruit concentrates are the natural juices reduced to the consistency of sirups. Usually little or no sugar is added. Several fruit products factories in this state have facilities for concentrating fruit juices *in vacuo* in glass-lined vacuum pans, and other factories use the freezing process. Of the concentrates available, orange and grape are the most satisfactory. Products made from various berries and pomegranates by vacuum concentration are inferior; besides having poor flavor and color, they sometimes develop a very disagreeable astringent taste. Most of those from metal vacuum pans have a metallic taint.

Juices concentrated by freezing possess much more of the fresh fruit flavor than do those made by vacuum concentration but are not available commercially. Lemon concentrate, however, is liable to taste stale and to be unsuitable for use in water ice.

If the technique¹³ of preparing fruit concentrates is improved so that the fresh fruit flavor and color are well retained, such products should find a considerable market in the ice cream industry. The present commercial products, however, are considerably inferior in flavor to the fresh and should be used only when the fresh fruit is not available. Only the orange and grape concentrates will be discussed further: present methods of manufacture must be greatly improved before the other concentrates will be very satisfactory for use in water ices.¹⁴

Orange Concentrate.—The freshly prepared concentrates and those held at 0° to 5° F have been used with fair success in water ice, provided a small amount of fresh juice is also used to mask the cooked taste. If stored at room temperature, the concentrates soon darken in color, finally becoming almost black, and also acquire a strong medicinal or “stale” flavor. Orange concentrate, therefore, should be purchased within a few days after manufacture and should be stored in the hardening room or used very soon after purchase.

The following formula has given good results:

Orange concentrate	1½ pounds
Water	6 pints
Fresh orange juice.....	6 pints
Orange oil	about 10 drops
Basic mix to give 5 gallons.	

¹³ For various processes of concentrating fruit juices, see: Irish, J. H. Fruit juice concentrates. California Agr. Exp. Sta. Bul. 392:1-20. 1925.

¹⁴ The names of manufacturers of fruit concentrates and fruit juices and dealers in equipment used in preparing fruits for use in ice cream will be supplied, upon request, by the Division of Viticulture and Fruit Products, University of California, Berkeley.

The basic mix should be prepared with about 6 ounces of citric acid to every 100 pounds. Use orange color as needed. Freeze to not over 35 per cent overrun.

Grape Concentrate.—Only grape concentrate of red color has proved satisfactory. The color must be a deep purplish red, not a reddish brown. To furnish flavor, some fresh or bottled grape juice may well be added. The following formula can be recommended :

Grape concentrate (red).....	1 quart
Water	2 quarts
Fresh or bottled Concord, Isabella, or Muscat juice.....	2 quarts
Basic mix to give 5 gallons.	

The basic mix should be made with about 6 ounces of citric acid to every 100 pounds. Freeze to not over 35 per cent overrun.

THE USE OF FRUIT SIRUPS IN WATER ICES

Fruit sirups differ from fruit concentrates in that they are prepared with enough cane or beet sugar to give a sirupy consistency. They may be preserved by heat, cold storage, sodium benzoate, or by very high sugar content (above 70 per cent).

Although fairly satisfactory in most cases, the sirups have so high a sugar content that one must dilute them considerably with water in order not to depress the freezing point of the water ice too greatly and at the same time to maintain the proper balance between the sugars. Due allowance for the sugar can be made, however, in preparing the basic mix.

Blackberry and loganberry sirups have particularly good flavor and color; strawberry sirup possesses a pronounced fresh berry taste, but lacks color. Orange sirup is satisfactory if not stored too long (three months or more) before use, or if stored at 32° F or a lower temperature. In freezing storage (0° to 10° F), orange sirup has retained its flavor for more than three and a half years.

In general, one volume of a fruit sirup diluted with three volumes of water will replace fresh juices in formulas previously given. *Not less than 6 quarts* of the diluted sirups should, however, be used with basic mix to give 5 gallons.

THE USE OF FRUITS IN OTHER FROZEN DESSERTS AND SPECIALTIES

In several other frozen desserts, fruits are customarily used or may be employed to good advantage. One of these, frozen plum pudding, is very popular during the holiday season. Several others described below also merit consideration.

Frozen Plum Pudding.—This dessert is made with cream, to which are added various dried and candied fruits, nuts, and usually eggs. Although very rich, it is in demand for the Thanksgiving and Christmas holiday dinners. Of various formulas, the following is typical:¹⁵

5 to 10 dozen egg yolks	3 tablespoons ground cinnamon
1 pound cocoa	½ teaspoon ground cloves
4 pounds candied cherries and assorted candied fruits	45 pounds standard high fat mix (Spices should be stirred into the fruits before being added to the cream)
1 to 2 pounds raisins	
2 pounds figs (dry)	
1 pound walnut meats	

Beat the egg yolks with the mix (1 dozen to each quart), heat slowly to 145°–165° F, and add to the remainder of the mix. Add the mixture of fruits, nuts, chocolate, and spices during freezing.

Nesselrode Pudding.—A satisfactory formula in commercial use is as follows:

Grind together:	Add 5 to 10 dozen egg yolks (prepared as for plum pudding)
1 pound assorted candied fruit	Vanilla as desired (usually same as for vanilla ice cream)
6 pounds maraschino cherries	Color as desired
2 pounds candied pineapple	45 pounds standard high fat mix
6 pounds candied cherries	
4 pounds raisins	
4 pounds macaroons	
4 pounds almonds	

Prepare and freeze like plum pudding.

Tutti Frutti Ice Cream (Parfait).—There are many commercial formulas for this ice cream. Instead of the fresh or cold-pack fruits, candied and sweetened crushed fruits are generally used.

The following formula has proved satisfactory:

5 to 10 dozen egg yolks	3 pounds pineapple
3 pounds candied cherries or maraschino cherries	Vanilla as desired (usually same as for vanilla ice cream)
2 to 3 pounds candied assorted fruits	45 pounds of standard or high fat mix

The assorted fruits should be pitted and ground before being added to the ice cream and had best be soaked overnight in the juice of the pineapple. This cream is popular in bricks and in combinations with other creams.

¹⁵ This formula and the one for Nesselrode pudding are taken from Turnbow, G. D., and L. A. Raffetto. Ice cream. John Wiley and Sons. 1928.

Most of the crushed fruit mixtures prepared especially for use in tutti frutti are satisfactory. They should not contain an excessive proportion of shredded coconut.

Au Fait.—Au fait, a brick ice cream, consists of layers of one or more kinds of cream with fruit, whole or in large pieces, between them. Halved candied figs, whole candied cherries, pieces of other candied fruits, various well-drained fruit preserves, and well-cooked dried figs cut in half, can be used. The au fait is especially good if one or more layers of the brick consist of fruit ice creams such as orange, strawberry, or pineapple.

Lacto.—Lacto is made with skim milk or whole milk, soured with lactic acid culture and mixed with sugar and eggs. Fruit juices may be added. The following formula is typical:

Lacto milk (starter, slightly sour skim milk or whole milk).....	6 gallons
Sugar	18 pounds
Eggs	2 dozen
Lemon juice.....	3 pints
Fruit juice or crushed fruit (with sugar added if necessary).....	2 quarts

Dissolve the sugar in the lacto milk. Beat the egg whites and yolks separately. Add to the milk and strain through a fine screen or gauze. Pour in the fruit juices and freeze to about 30 per cent less overrun than for ice cream. This recipe can be improved by adding some milk-solids-not-fat in the form of powdered or condensed milk and a small amount of stabilizer as with sherbets.

Fruit Mousse.—Crushed fruits and fruit juices are ideal for use in mousses, which consist essentially of whipped cream, sugar, and flavor. Their texture, which is generally coarse, with marked stratification, may be improved by the following procedure: Whip 2 gallons of 35 per cent cream and 4 pounds of sugar in the freezer. Slowly add 2½ gallons of soft ice cream as drawn from the freezer, whipping just enough to mix thoroughly. Flavor with 1 gallon of fruit pulp or fruit juice, and color as desired. This formula does not have the tendency to stratify or become grainy, as when only cream is whipped.

Fruit Frappés.—A frappé is an ice consisting of water, sugar, and natural flavoring, chilled to a soft, semifrozen consistency. Semifrozen fruit punches are often prepared with fermented fruit^{*} juices or other alcoholic beverages; but experiments have demonstrated that excellent fruit frappés can also be made with the unfermented juices.

The following formulas, among others, have proved satisfactory. These are given for 10-gallon quantities:

Formula 1

Orange juice	8 quarts
Lemon juice	2 quarts
Grape juice (Concord or Pierce Isabella).....	6 quarts
Sugar	20 pounds
Water to make a total of 10 gallons.	

Formula 2

Orange juice	8 quarts
Lemon juice	3 quarts
Grapefruit juice	3 quarts
Strong green tea.....	2½ to 4 quarts
Ginger ale (add just before serving).....	2 quarts
Sugar	9 pounds
Water to make a total of 10 gallons.	

Other fruit juices may be substituted for the grape in formula 1. If these are very sour, like loganberry, use less lemon. The combinations of juices used in punch are numerous. Pineapple, loganberry, strawberry, blackberry, raspberry, and pomegranate juices are particularly desirable additions. The sirup from cold-pack berries and from maraschino cherries possesses great flavoring power in fruit punches.

Frozen "Suckers."—A specialty known by the trade as "frozen suckers" is on the market and in some localities has proved fairly popular. The product is prepared by placing diluted ordinary soda water base, not carbonated, in molds and freezing it solid. Before freezing, a wooden skewer is inserted in the liquid to furnish a handle for holding the frozen sucker as it is consumed. After the tubes have been immersed in warm water for a moment to melt the ice, the frozen suckers are removed, wrapped in paper, and packed in ice cream cans.

Until 4 or 5 years ago they were made by diluting with water such standard soda water sirups as ginger ale, and the various imitation fruit sirups, such as orange, lemon, grape, and strawberry. Experiments in the Fruit Products Laboratory have, however, proved that fruit juices and fruit sirups diluted with water are superior in flavor to the imitation fruit products for the preparation of frozen suckers.

The sugar content of the juices or diluted sirup must not be greater than about 15 per cent; liquids testing about 12° Balling give the best results. If too high in solids—that is, "too sweet"—the product either will not solidify or will be soft. If too dilute, it will be too hard when frozen and will lack flavor.